Lightweight High Temperature Non-Eroding Throat Materials for Propulsion Systems, Phase I

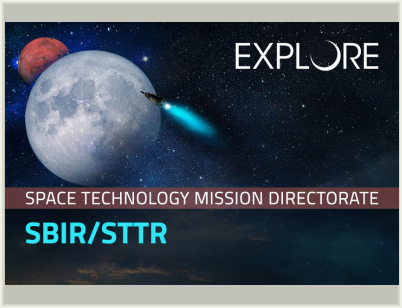
Completed Technology Project (2007 - 2007)

Project Introduction

The innovation in this proposed effort is the development of lightweight, non-eroding nozzle materials for use in propulsion systems. Lightweight structures are desirable for space transportation vehicle systems in order to reduce launch costs, increase mission flexibility/efficiency, and add robustness with respect to the ability to add weight or additional materials to the mission with minimum sacrifice in performance. The use of non-eroding materials, coupled with lightweight materials, as rocket nozzles can further increase mission flexibility by allowing an increase in performance, higher maximum temperatures, greater speeds, greater range, bigger payloads, and longer lifetimes. The higher maximum temperatures may eliminate the need for cooling air, while simultaneously increasing engine efficiency. Higher maximum use temperature additionally allows for increased stagnation temperatures and pressures, increasing the propellant enthalpy, which, in return, can significantly increase the velocity and performance of the projectile. These benefits result in increased fuel savings. The advanced materials study will include monolithic ceramics, refractory metals, and high temperature ceramic matrix composite (CMC) materials. The manufacturing processes for the monolithic ceramics and refractory metal materials will include hot isostatic processing (HIP), vacuum plasma spraying (VPS), electrodeposition. The CMC fabrication processes will include braiding, filament winding, tape wrapping, and involute layup.

Anticipated Benefits

The results of this lightweight, high temperature, non-eroding nozzle material study will have broad ranging applications in the civil aerospace, governmental aerospace companies, as well as aircraft jet engine manufactures and power generation equipment manufacturing companies. Potential customers include Boeing, Lockheed Martin, General Electric Power Systems, and ATK-Thiokol. MR&D's core business is design and structural analysis of high temperature materials. The fundamental technology and design tools developed in this SBIR program will allow us to expand our client base and offer more capabilities to our existing customers. Additionally, the technology developed here will be translated to other commercial and government applications to expand the market for refractory material leading edges, nozzles, hypersonic airframes and ramjet engines.



Lightweight High Temperature Non-Eroding Throat Materials for Propulsion Systems, Phase I

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

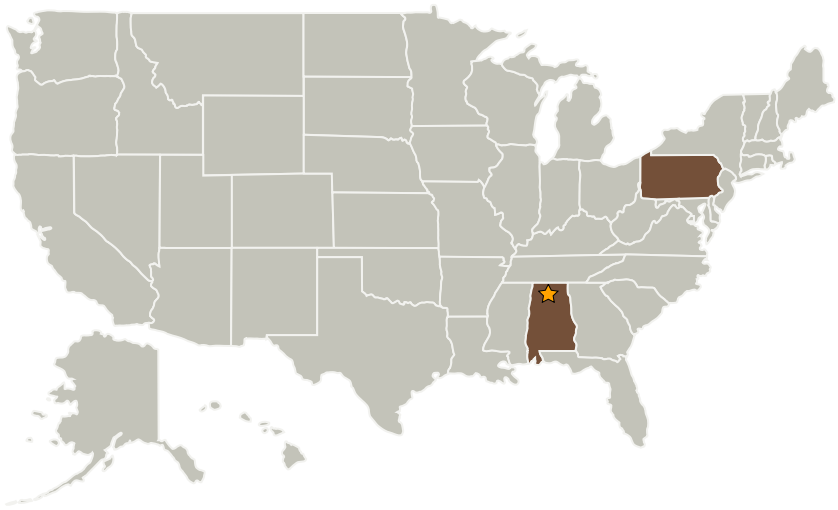
Small Business Innovation Research/Small Business Tech Transfer

Small Business Innovation Research/Small Business Tech Transfer

Lightweight High Temperature Non-Eroding Throat Materials for Propulsion Systems, Phase I

Completed Technology Project (2007 - 2007)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Materials Research and Design, Inc.	Supporting Organization	Industry	Wayne, Pennsylvania

Primary U.S. Work Locations	
Alabama	Pennsylvania

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Project Manager:
Robert R Hickman

Principal Investigator:
Joseph Pluscauskis

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.6 Materials for Electrical Power Generation, Energy Storage, Power Distribution and Electrical Machines